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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/469,652	12/22/1999	JONATHAN J. WIERER JR.	10992873-1	5235

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EXAMINER

CHU, CHRIS C

ART UNIT PAPER NUMBER

2815

DATE MAILED: 04/09/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/469,652

Applicant(s)

WIERER ET AL.

Examiner

Chris C. Chu

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1, 3 - 11 and 13 - 18 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1, 3 - 11 and 13 - 18 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on 06 July 2001 is: a) ☐ approved b) ☒ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_ 6) ☐ Other: \_\_\_\_

## **DETAILED ACTION**

### ***Response to Amendment***

1. Applicant's amendment filed on January 4, 2002 has been received and entered in the case.

### ***Drawings***

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: reference character 21 in Figure 3 are not described in the specification.

Correction is required.

3. Applicant is required to submit a proposed drawing correction in reply to this Office action. However, formal correction of the noted defect can be deferred until the application is allowed by the examiner.

### ***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1, 4, 8 ~ 11 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. in view of Haitz et al.

Regarding claim 1, Biing-Jye et al. discloses in Fig. 2A and column 3, lines 22 ~ 24 a light emitting device comprising:

- a semiconductor heterostructure ( $\text{Al}_2\text{O}_3$ ) including at least one p-type layer (p-GaN) and one n-type layer (n-GaN); and
- a p contact (p-ohmic) and an n contact (n-ohmic), the p contact electrically connected to the p-type layer, the n contact electrically connected to the n-type layer, wherein at least one of the p and n contacts is a multi-layer contact external to the semiconductor heterostructure and including a metallic reflector layer and a continuous conductive layer that makes ohmic contact to the heterostructure.

Biing-Jye et al. does not disclose the multi-layer contact having a reflectivity greater than 75% for light at an operating wavelength of the light-emitting device. Haitz et al. discloses in Fig. 1 and column 3, lines 16 ~ 28 a multi-layer contact having a reflectivity greater than 75% for light at an operating wavelength of a light-emitting device. It would have been obvious to one of ordinary skill in the art at the time of the present invention was made to use the reflectivity greater than 75% of Haitz et al. in the light-emitting device of Biing-Jye et al. in order to decrease photons absorption as taught by Haitz et al. in column 2, lines 5 ~ 8.

Regarding claims 4 and 14, Haitz et al. discloses in column 3, lines 31 ~ 34 the multi-layer contact further comprising a barrier layer interposing the reflector layer and the conductive layer.

Regarding claim 8, Biing-Jye et al. discloses in Fig. 2A the p and n contacts are on opposing faces of the heterostructure.

Regarding claim 9, Haitz et al. discloses in column 3, lines 31 ~ 34 the conductive layer that makes ohmic contact to the heterostructure includes Ni and Ag.

Regarding claim 10, Haitz et al. discloses in column 3, lines 31 ~ 34 the reflector layer is Ag.

Regarding claim 11, Biing-Jye et al. discloses in Fig. 2A and column 3, lines 22 ~ 24 a light-emitting semiconductor device comprising:

- a GaN-based semiconductor heterostructure (GaN) having at least one p-type layer (p-GaN) and one n-type layer (n-GaN); and
- a p contact (p-ohmic) and an n contact (n-ohmic), the p contact electrically connected to the p-type layer, the n contact electrically connected to the n-type layer, wherein at least one of the p and n contacts is a multi-layer contact external to the semiconductor heterostructure and including a metallic reflector layer and a continuous conductive layer that makes ohmic contact to the heterostructure.

Biing-Jye et al. does not disclose the multi-layer contact having a reflectivity greater than 75% for light at an operating wavelength of the light-emitting device. Haitz et al. discloses in Fig. 1 and column 3, lines 16 ~ 28 a multi-layer contact having a reflectivity greater than 75% for light at an operating wavelength of a light-emitting device. It would have been obvious to one

of ordinary skill in the art at the time of the present invention was made to use the reflectivity greater than 75% of Haitz et al. in the light-emitting device of Biing-Jye et al. in order to decrease photons absorption as taught by Haitz et al. in column 2, lines 5 ~ 8.

6. Claims 3 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. and Haitz et al. as applied to claims 1 and 11 above, and further in view of Sugiura et al.

Biing-Jye et al. and Haitz et al. do not disclose the contact resistance of the multi-layer contact of the light-emitting device, which is less than  $0.01 \Omega\text{-cm}^2$ . However, Sugiura et al. discloses in column 5, lines 27 – 32 a contact resistance of the multi-layer contact having less than  $0.01 \Omega\text{-cm}^2$ . It would have been obvious to one of ordinary skill in the art at the time of the present invention was made to use the contact resistance which is less than  $0.01 \Omega\text{-cm}^2$  of Sugiura et al. in the light-emitting device of Biing-Jye et al. and Haitz et al. in order to improve ohmic contact as taught by Sugiura et al. in column 5, lines 26 ~ 28.

7. Claims 5 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. and Haitz et al. as applied to claims 1 and 11 above, and further in view of Nakagawa et al.

Biing-Jye et al. and Haitz et al. disclose the claimed invention except the thickness of the reflector layer, which is greater than 500 angstroms. However, Nakagawa et al. discloses the thickness of the reflector layer to be “(Ti/Pd/Ag (400nm/200nm/1 $\mu\text{m}$  thick))” (column 19, lines 45 – 48). Thus, it would have been obvious to one of ordinary skill in the art at the time when the

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invention was made to further modify Biing-Jye et al. by increasing the thickness of the reflector layer to be greater than 500 angstroms. The ordinary artisan would have been motivated to further modify Biing-Jye et al. in the manner described above for at least the purpose of increasing the reflection and to have a high quality semiconductor layer (column 19, line 57 – 59).

8. Claims 6 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. and Haitz et al. as applied to claims 1 and 11 above, and further in view of Liu et al.

Biing-Jye et al. and Haitz et al. disclose all of the claimed invention except the thickness of the ohmic contact layer, which is less than 200 angstroms. However, Liu et al. discloses the thickness of the ohmic contact layer, which is less than 200 angstroms (column 4, lines 60 – 63). Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to further modify Biing-Jye et al. by adding less than 200 angstroms for the thickness of the ohmic contact layer as taught by Liu et al. The ordinary artisan would have been motivated to further modify Biing-Jye et al. in the manner described above for at least the purpose of improving the transistor performances (column 2, lines 43 ~ 46).

9. Claims 7 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. and Haitz et al. as applied to claims 1 and 11 above, and further in view of Schetzina.

Biing-Jye et al. and Haitz et al. do not disclose the reflector layer being selected from a group that includes Al, Cu, Rh, Pd, and Au. Schetzina discloses in column 18, lines 48 ~ 50 a reflector layer being selected from a group that includes Al, Cu, Rh, Pd, and Au. It would have

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been obvious to one of ordinary skill in the art at the time of the present invention was made to select from the group that includes Al, Cu, Rh, Pd, and Au of Schetzina as the reflector layer in the light-emitting device of Biing-Jye et al. and Haitz et al. in order to provide an optically reflecting metal ohmic contact as taught by Schetzina in column 18, lines 48 ~ 53.

10. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. and Haitz et al. as applied to claim 11 above, and further in view of Okazaki.

Biing-Jye et al. and Haitz et al. disclose the claimed invention except the ohmic contact layer, which is selected from a group that consist of Ti, Au/NiO, and Ni/Au. However, Okazaki discloses that the material of the ohmic contact layer (13) is selected from a group of “titanium (Ti), nickel (Ni), etc.” (column 8, lines 9 – 14 and column 8, lines 32 – 37). Therefore, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to further modify Biing-Jye et al. by selecting from a group that consist of Ti, Au/NiO, and Ni/Au for the ohmic contact layer as taught by Okazaki. The ordinary artisan would have been motivated to further modify Biing-Jye et al. in the manner described above for at least the purpose of decreasing the ohmic contact resistance between the layers and increasing the reflectivity of the ohmic contact layer.

### ***Response to Arguments***

11. Applicant's arguments with respect to claims 1, 3 – 11 and 13 - 18 have been considered but are moot in view of the new ground(s) of rejection.



***Conclusion***

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chris C. Chu whose telephone number is (703) 305-6194. The examiner can normally be reached on M-F (10:30 - 7:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on (703) 308-1690. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7382 for regular communications and (703) 308-7722 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Chris C. Chu  
Examiner  
Art Unit 2815

c.c.  
April 4, 2002

A handwritten signature in black ink, appearing to read 'Eddie Lee', with a large, sweeping initial 'E'.

EDDIE LEE  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 2800